

## CLAIMS

What is claimed is:

1. A multi-channel, low input capacitance signal probe head comprising:

at least a first substrate having a plurality of input signal pads formed thereon with the input signal pads being exposed on one end of the substrate;

a housing having at least a first open end and a substrate support member that receives the substrate such that the input signal pads are exposed at the open end of the housing; and

a removable signal contact holder mounted to the housing and supporting electrically conductive elastomer signal contacts with the holder disposed over the open end the housing such that the elastomer signal contacts engage the input signal pads.

2. The multi-channel, low input capacitance signal probe head as recited in claim 1 further comprising a second substrate having a plurality of input signal pads formed thereon with the input signal pads being exposed on one end of the substrate with the substrate support member receiving the second substrate such that the support member is disposed between the first and second substrate and the input signal pads on the second substrate are exposed at the open end of the housing.

3. The multi-channel, low input capacitance signal probe head as recited in claim 1 wherein the housing further comprises opposing sidewalls separated by opposing front and back walls with each sidewall having a latching recess formed therein adjacent to the open end of the housing, and bores formed through the housing on either side of the substrate that are perpendicular to the open end of the housing.

4. The multi-channel, low input capacitance signal probe head as recited in claim 3 wherein the removable signal contact holder further comprises a planar frame member and latching members extending perpendicular from either end of the frame member with at least a first slot formed in the frame member aligned with the input signal pads on the substrate for receiving the electrically conductive elastomer signal contacts.

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5. The multi-channel, low input capacitance signal probe head as recited in claim 4 wherein the latching members further comprise inwardly facing latching ramps with each latching ramp having a terminating ledge that engage the latching recesses in the housing sidewalls.

6. The multi-channel, low input capacitance signal probe head as recited in claim 4 further comprising at least a first alignment rib formed parallel to the slot on the planar frame that engages a corresponding recess formed in the housing.

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7. The multi-channel, low input capacitance signal probe head as recited in claim 4 wherein the frame member further comprises apertures formed on either side of the slot and aligned with the bores in the housing.

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8. The multi-channel, low input capacitance signal probe head as recited in claim 7 further comprising a probe head retention member for securing the multi-channel signal probe head to a device under test.

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9. The multi-channel, low input capacitance signal probe head as recited in claim 8 wherein the removable signal contact holder further comprises flanges formed adjacent to the apertures and extending in a direction opposite from the latching members.

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10. The multi-channel, low input capacitance signal probe head as recited in claim 9 wherein the device under test is a circuit board having an array of signal contact pads on at least one surface thereof corresponding to the electrically conductive elastomer signal contacts, and through holes formed on either side of the array of signal contact pads, the probe head retention member further comprising attachment members extending through the bores in the housing and threadably mating with retention nuts mounted to the opposite side of the circuit board from the contact pads that are aligned with the through holes to secure the signal probe head to the device under test.

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11. The multi-channel, low input capacitance signal probe head as recited in claim 10 wherein the attachment members comprise threaded screws.

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12. The multi-channel, low input capacitance signal probe head as recited in claim 8 wherein the device under test is a circuit board having an array of signal contact pads on at least one surface thereof corresponding to the electrically conductive elastomer signal contacts and through holes formed on either side of the array of signal contact pads aligned with the bores in the housing, the probe head retention member further comprising attachment members extending through the bores in the housing and threadably mating with threaded apertures disposed in a retention block positioned on the opposite side of the circuit board from the contact pads that are aligned with the through holes in the circuit board to secure the signal probe head to the device under test.

13. The multi-channel, low input capacitance signal probe head as recited in claim 12 wherein the attachment members comprise threaded screws.

14. The multi-channel, low input capacitance signal probe head as recited in claim 12 wherein the retention block further comprises alignment flanges formed adjacent to the threaded apertures having an exterior surface closely mating with and extending through the through holes in the circuit board.

15. The multi-channel, low input capacitance signal probe head as recited in claim 14 wherein the housing further comprises second bores extending from the open end of the housing and coaxial with the first bores, each second bore having a diameter larger than the first bore and sized to closely receive one of the alignment flanges extending above the circuit board.

16. The multi-channel, low input capacitance signal probe head as recited in claim 14 wherein the flanges include latching members extending outward from the flanges to engage the top surface of the circuit board.

17. The multi-channel, low input capacitance signal probe head as recited in claim 16 wherein the housing further comprises notches formed adjacent to the open end of the housing that closely receive in the latching members.

18. The multi-channel, low input capacitance signal probe head as recited in

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claim 12 wherein the retention block further comprises an elongated rectangular housing having exterior walls forming an interior chamber that receives a stiffener block having the threaded apertures formed therein.

5           19. The multi-channel, low input capacitance signal probe head as recited in claim 18 wherein the rectangular housing further comprises alignment flanges extending from one of the exterior walls adjacent to the threaded apertures and having an exterior surface closely mating with and extending through the through holes in the circuit board.

10           20. The multi-channel, low input capacitance signal probe head as recited in claim 19 wherein the housing further comprises second bores extending from the open end of the housing and coaxial with the first bores, each second bore having a diameter larger than the first bore and sized to closely receiving one of the alignment flanges extending above the circuit board.

15           21. The multi-channel, low input capacitance signal probe head as recited in claim 19 wherein the alignment flanges include latching members extending outward from the flanges to engage the top surface of the circuit board.

20           22. The multi-channel, low input capacitance signal probe head as recited in claim 21 wherein the housing further comprises notches formed adjacent to the open end of the housing that closely receive in the latching members.

25           23. The multi-channel, low input capacitance signal probe head as recited in claim 3 wherein the housing further comprises:

          a substrate carrier forming the substrate support member that receives the substrate with the input signal pads on the substrate being exposed at one end of the carrier; and

30           a substrate carrier cover having exterior walls forming an interior chamber that receives the substrate carrier and substrate with the exterior walls forming the opposing sidewalls and front and back walls of the housing.

          24. The multi-channel, low input capacitance signal probe head as recited in

claim 23 wherein the substrate carrier further comprises opposing stiles and rails with the stiles and at least one rail having recesses formed on one surface thereof for receiving the substrate with the end of the substrate having the signal pads extending to the end of the rail having the recess.

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25. The multi-channel, low input capacitance signal probe head as recited in claim 24 wherein the stiles include the housing bores.

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26. The multi-channel, low input capacitance signal probe head as recited in claim 24 further comprising a second substrate having a plurality of input signal pads thereon with the input signal pads being exposed on one end of the substrate with the stiles and the one rail having recesses formed on the reverse side thereof for receiving the second substrate with the end of the substrate having the signal pads extending to the end of the rail having the recess.

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27. A multi-channel, low input capacitance signal probe head system mountable on a device under test having an array of signal contact pads on at least one surface of a circuit board and through holes formed on either side of the array of signal contact pads comprising:

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at least a first substrate having a plurality of input signal pads formed thereon with the input signal pads being exposed on one end of the substrate;

a housing having at least a first open end and a substrate support member that receives the substrate such that the input signal pads are exposed at the open end of the housing;

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→ a probe head retention member having bores formed through the housing on either side of the substrate that are perpendicular to the open end of the housing and attachment members extending through the bores in the housing and threadably mating with threaded apertures mounted to the opposite side of the circuit board from the contact pads that are aligned with the through holes in the circuit board to secure the signal probe head to a device under test; and

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a removable signal contact holder mounted to the housing and supporting electrically conductive elastomer signal contacts with the holder having apertures formed on either side of the elastomer signal contacts and aligned with the bores in the housing, the holder disposed over the open end the housing such that the

5      elastomer signal contacts engage the input signal pads.

10      28. The multi-channel, low input capacitance signal probe head system as recited in claim 27 further comprising a second substrate having a plurality of input signal pads formed thereon with the input signal pads being exposed on one end of the substrate with the substrate support member receiving the second substrate such that the support member is disposed between the first and second substrate and the input signal pads on the second substrate are exposed at the open end of the housing.

15      29. The multi-channel, low input capacitance signal probe head system as recited in claim 27 wherein the housing further comprises opposing sidewalls separated by opposing front and back walls with each sidewall having a latching recess formed therein adjacent to the open end of the housing.

20      30. The multi-channel, low input capacitance signal probe head system as recited in claim 29 wherein the removable signal contact holder further comprises a planar frame member and latching members extending perpendicular from either end of the frame member with at least a first slot formed in the frame member aligned with the input signal pads on the substrate that receive the electrically conductive elastomer signal contacts and the latching members having inwardly facing latching ramps with each latching ramp having a terminating ledge that engage the latching recesses in the housing sidewalls.

25      31. The multi-channel, low input capacitance signal probe head system as recited in claim 30 further comprising at least a first alignment rib formed parallel to the slot on the planar frame that engages a corresponding recess formed in the housing.

30      32. The multi-channel, low input capacitance signal probe head system as recited in claim 27 wherein the removable signal contact holder further comprises flanges formed adjacent to the apertures and extending in a direction opposite from the latching members.

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33. The multi-channel, low input capacitance signal probe head system as recited in claim 32 wherein the threaded apertures of the probe head retention member are formed in retention nuts secured to the opposite side of the circuit board over the through holes to receive the attachment members.

34. The multi-channel, low input capacitance signal probe head system as recited in claim 33 wherein the attachment members comprise screws threadably mating with the retention nuts.

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35. The multi-channel, low input capacitance signal probe head system as recited in claim 27 wherein the probe head retention member further comprises a retention block positioned on the opposite side of the circuit board from the contact pads having the threaded apertures formed therein that are aligned with the through holes to receive the attachment members.

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36. The multi-channel, low input capacitance signal probe head system as recited in claim 35 wherein the attachment members comprise threaded screws.

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37. The multi-channel, low input capacitance signal probe head system as recited in claim 35 wherein the retention block further comprises alignment flanges formed adjacent to the threaded apertures having an exterior surface closely mating with and extending through the through holes in the circuit board with the flanges having latching members extending outward from the flanges to engage the top surface of the circuit board.

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38. The multi-channel, low input capacitance signal probe head system as recited in claim 37 wherein the housing further comprises second bores extending from the open end of the housing and coaxial with the first bores, each second bore having a diameter larger than the first bore and sized to closely receive one of the alignment flanges extending above the circuit board and notches formed adjacent to the open end of the housing that closely receive in the latching members.

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39. The multi-channel, low input capacitance signal probe head system as recited in claim 35 wherein the retention block further comprises an elongated

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rectangular housing having exterior walls forming an interior chamber that receives a stiffener block having the threaded apertures formed therein.

10 40. The multi-channel, low input capacitance signal probe head system as recited in claim 39 wherein the rectangular housing further comprises alignment flanges extending from one of the exterior walls adjacent to the threaded apertures and having an exterior surface closely mating with and extending through the through holes in the circuit board with the flanges having latching members extending outward from the flanges to engage the top surface of the circuit board.

15 41. The multi-channel, low input capacitance signal probe head system as recited in claim 40 wherein the housing further comprises second bores extending from the open end of the housing and coaxial with the first bores, each second bore having a diameter larger than the first bore and sized to closely receive one of the alignment flanges extending above the circuit board and notches formed adjacent to the open end of the housing that closely receive in the latching members.

20 42. The multi-channel, low input capacitance signal probe head system as recited in claim 29 wherein the housing further comprises:

25 a substrate carrier forming the substrate support member that receives the substrate with the input signal pads on the substrate being exposed at one end of the carrier; and

25 a substrate carrier cover having exterior walls forming an interior chamber that receives the substrate carrier and substrate with the exterior walls forming the opposing sidewalls and front and back walls of the housing.

30 43. The multi-channel, low input capacitance signal probe head system as recited in claim 42 wherein the substrate carrier further comprises opposing stiles and rails with the stiles and at least one rail having recesses formed on one surface thereof for receiving the substrate with the end of the substrate having the signal pads extending to the end of the rail having the recess.

44. The multi-channel, low input capacitance signal probe head system as recited in claim 43 wherein the stiles include the housing bores.



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45. The multi-channel, low input capacitance signal probe head system as recited in claim 43 further comprising a second substrate having a plurality of input signal pads thereon with the input signal pads being exposed on one end of the substrate with the stiles and the one rail having recesses formed on the reverse side thereof for receiving the second substrate with the end of the substrate having the signal pads extending to the end of the rail having the recess.

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46. A multi-channel, low input capacitance measurement probe for coupling a device under test having an array of signal contact pads on at least one surface of a circuit board and through holes formed on either side of the array of signal contact pads to a measurement instrument comprising:

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at least a first substrate having a plurality of input signal circuits and associated input signal pads formed thereon with the input signal pads being exposed on one end of the substrate and the input signal circuits being adjacent to and electrically coupled to the input signal pads;

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a housing having a substrate carrier and substrate carrier cover with the substrate carrier receiving the substrate such that the input signal pads on the substrate are exposed at one end of the carrier and the substrate carrier cover having opposing sidewalls separated by opposing front and back walls forming an open ended chamber that receives the substrate carrier and substrate such that the input signal pads are exposed at one of the open ends of the cover with each sidewall having a latching recess formed therein adjacent to the open end of the housing;

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a probe head retention member having bores formed through the substrate carrier on either side of the substrate that are perpendicular to the open end of the housing that are aligned with the through holes in the circuit board and attachment members extending through the bores in the substrate carrier and threadably mating with threaded apertures mounted to the opposite side of the circuit board from the contact pads and over the through holes to secure the measurement probe to a device under test;

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a removable signal contact holder having a planar frame member and latching members extending perpendicular from either end of the frame member with at least a first slot formed in the frame member aligned with the input signal pads on the substrate that receive electrically conductive elastomer signal contacts

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and the latching members having inwardly facing latching ramps with each latching ramp having a terminating ledge that engage the latching recesses in the housing sidewalls to mount the signal contact holder over the open end the housing such that the elastomer signal contacts engage the input signal pads with apertures formed on either side of the electrically conductive elastomer signal contacts that are aligned with the bores in the substrate carrier and the through holes on the circuit board; and

a multiple signal lines cable having the signal lines at one end electrically coupled to outputs of the input signal circuits and the signal lines at the other end electrically coupled to an input connector for coupling to the measurement instrument.

47. A multi-channel, low input capacitance measurement probe as recited in claim 46 further comprising at least a first alignment rib formed parallel to the slot on the planar frame that engages a corresponding recess formed in the substrate carrier.

48. The multi-channel, low input capacitance measurement probe as recited in claim 47 wherein the removable signal contact holder further comprises flanges formed adjacent to the apertures and extending in a direction opposite from the latching members.

49. The multi-channel, low input capacitance measurement probe as recited in claim 46 wherein the threaded apertures of the probe head retention member are formed in retention nuts secured to the opposite side of the circuit board over the through holes to receive the attachment members.

50. The multi-channel, low input capacitance measurement probe as recited in claim 49 wherein the attachment members comprise screws threadably mating with the retention nuts.

51. The multi-channel, low input capacitance measurement probe as recited in claim 46 wherein the probe head retention member further comprises a retention block positioned on the opposite side of the circuit board from the contact pads

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52. The multi-channel, low input capacitance measurement probe as recited in claim 51 wherein the attachment members comprise threaded screws.

53. The multi-channel, low input capacitance measurement probe as recited in claim 51 wherein the retention block further comprises alignment flanges formed adjacent to the threaded apertures having an exterior surface closely mating with and extending through the through holes in the circuit board with the flanges having latching members extending outward from the flanges to engage the top surface of the circuit board.

54. The multi-channel, low input capacitance measurement probe as recited in claim 53 wherein the housing further comprises second bores extending from the open end of the housing and coaxial with the first bores, each second bore having a diameter larger than the first bore and sized to closely receive one of the alignment flanges extending above the circuit board and notches formed adjacent to the open end of the housing that closely receive in the latching members.

55. The multi-channel, low input capacitance measurement probe as recited in claim 51 wherein the retention block further comprises an elongated rectangular housing having exterior walls forming an interior chamber that receives a stiffener block having the threaded apertures formed therein.

56. The multi-channel, low input capacitance measurement probe as recited in claim 55 wherein the rectangular housing further comprises alignment flanges extending from one of the exterior walls adjacent to the threaded apertures and having an exterior surface closely mating with and extending through the through holes in the circuit board with the flanges having latching members extending outward from the flanges to engage the top surface of the circuit board.

57. The multi-channel, low input capacitance measurement probe as recited in claim 56 wherein the housing further comprises second bores extending from the

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open end of the housing and coaxial with the first bores, each second bore having a diameter larger than the first bore and sized to closely receiving one of the alignment flanges extending above the circuit board and notches formed adjacent to the open end of the housing that closely receive in the latching members.

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58. The multi-channel, low input capacitance measurement probe as recited in claim 46 wherein the substrate carrier further comprises opposing stiles and rails with the stiles and at least one rail having recesses formed on one surface thereof for receiving the substrate with the end of the substrate having the signal pads extending to the end of the rail having the recess.

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59. The multi-channel, low input capacitance measurement probe as recited in claim 58 wherein the stiles include the substrate carrier bores.

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60. The multi-channel, low input capacitance measurement probe as recited in claim 58 further comprising a second substrate having a plurality of input signal circuits and associated input signal pads thereon with the input signal pads being exposed on one end of the substrate and the input signal circuits being adjacent to and electrically coupled to the input signal pads with the stiles and the one rail having recesses formed on the reverse side thereof for receiving the second substrate with the end of the substrate having the signal pads extending to the end of the rail having the recess.

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61. The multi-channel, low input capacitance measurement probe as recited in claim 46 further comprising a second substrate having a plurality of input signal circuits and associated input signal pads formed thereon with the input signal pads being exposed on one end of the substrate and the input signal circuits being adjacent to and electrically coupled to the input signal pads with the substrate support member receiving the second substrate such that the support member is disposed between the first and second substrate and the input signal pads on the second substrate are exposed at the open end of the housing.

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